NOAA FISHERIES

NW Fisheries Science Center

Overview of Pacific Coast Stock Assessments

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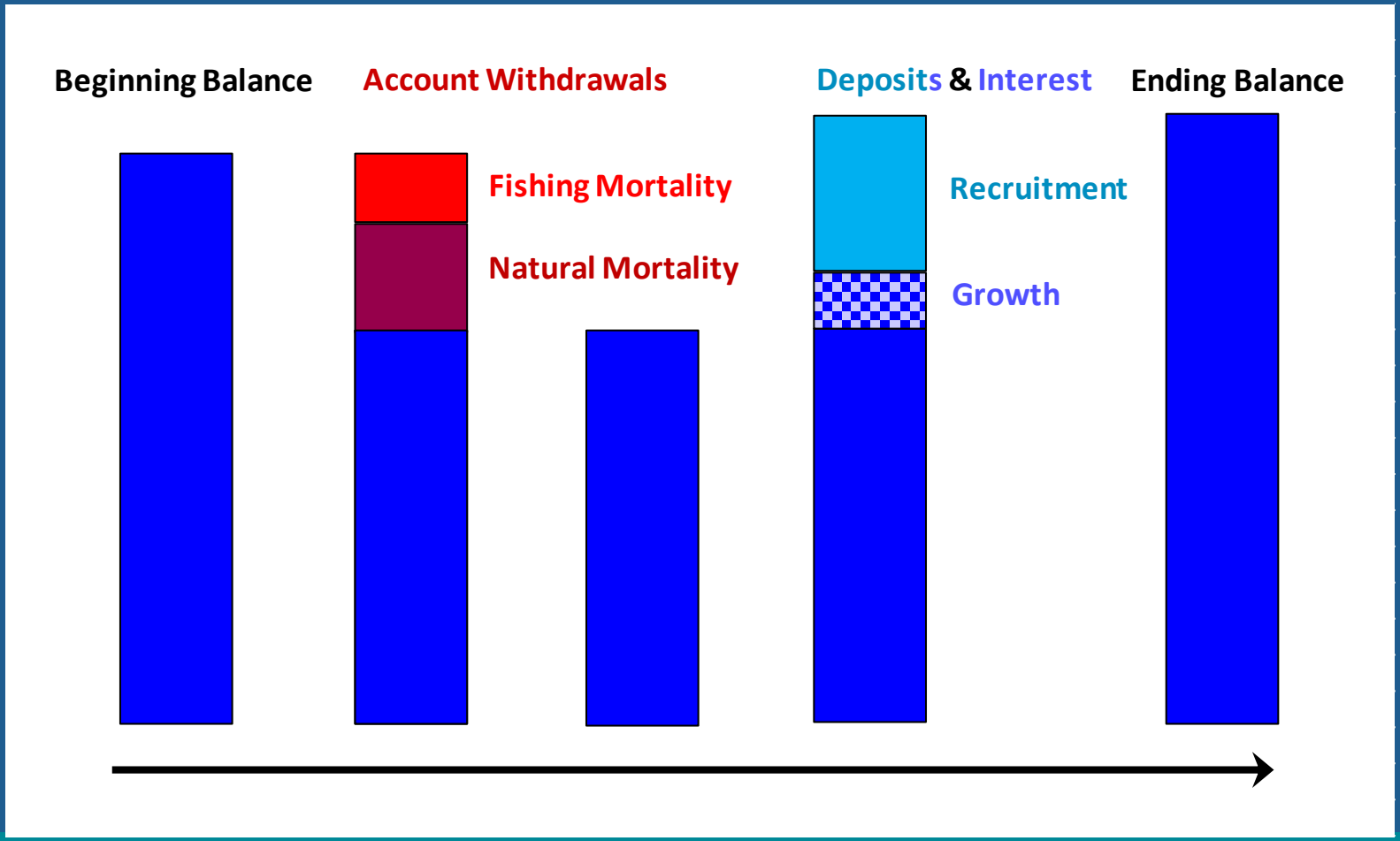
Outline

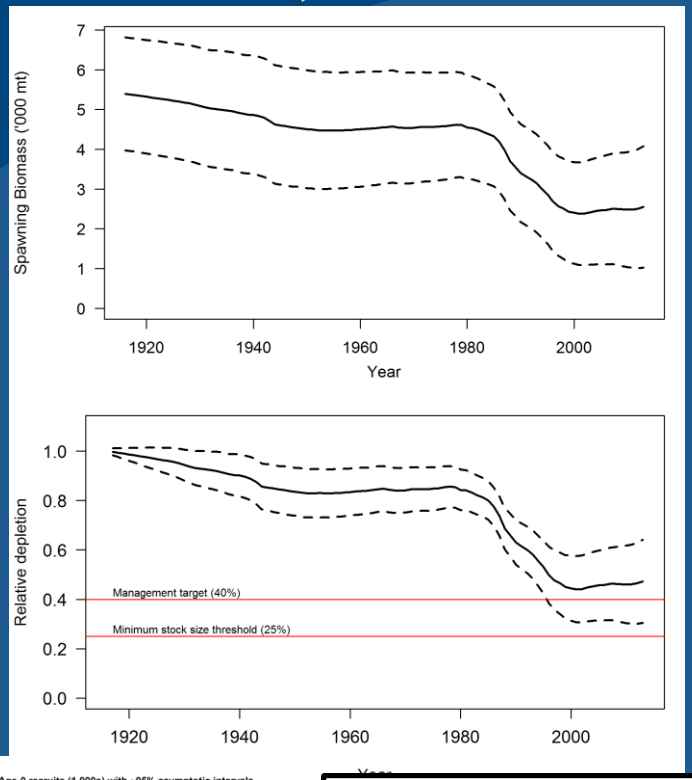
- What do we mean by Stock Assessment?
- Levels and Categories of assessments used for groundfish
- Types of data used in current assessments
- Brief Overview of assessments for 3 species

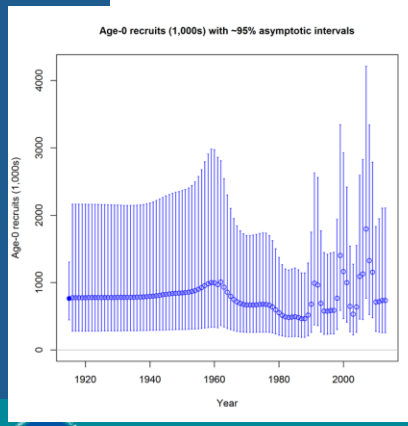
Stock Assessment Basics

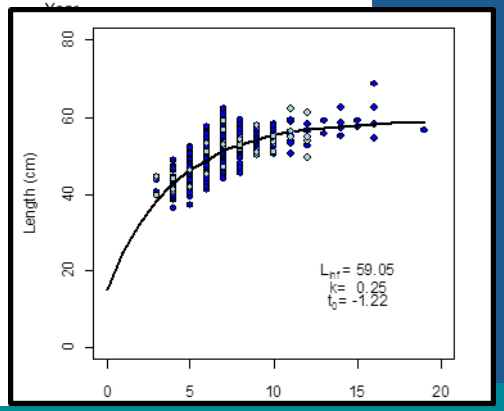
A fish population can be thought of like a bank account



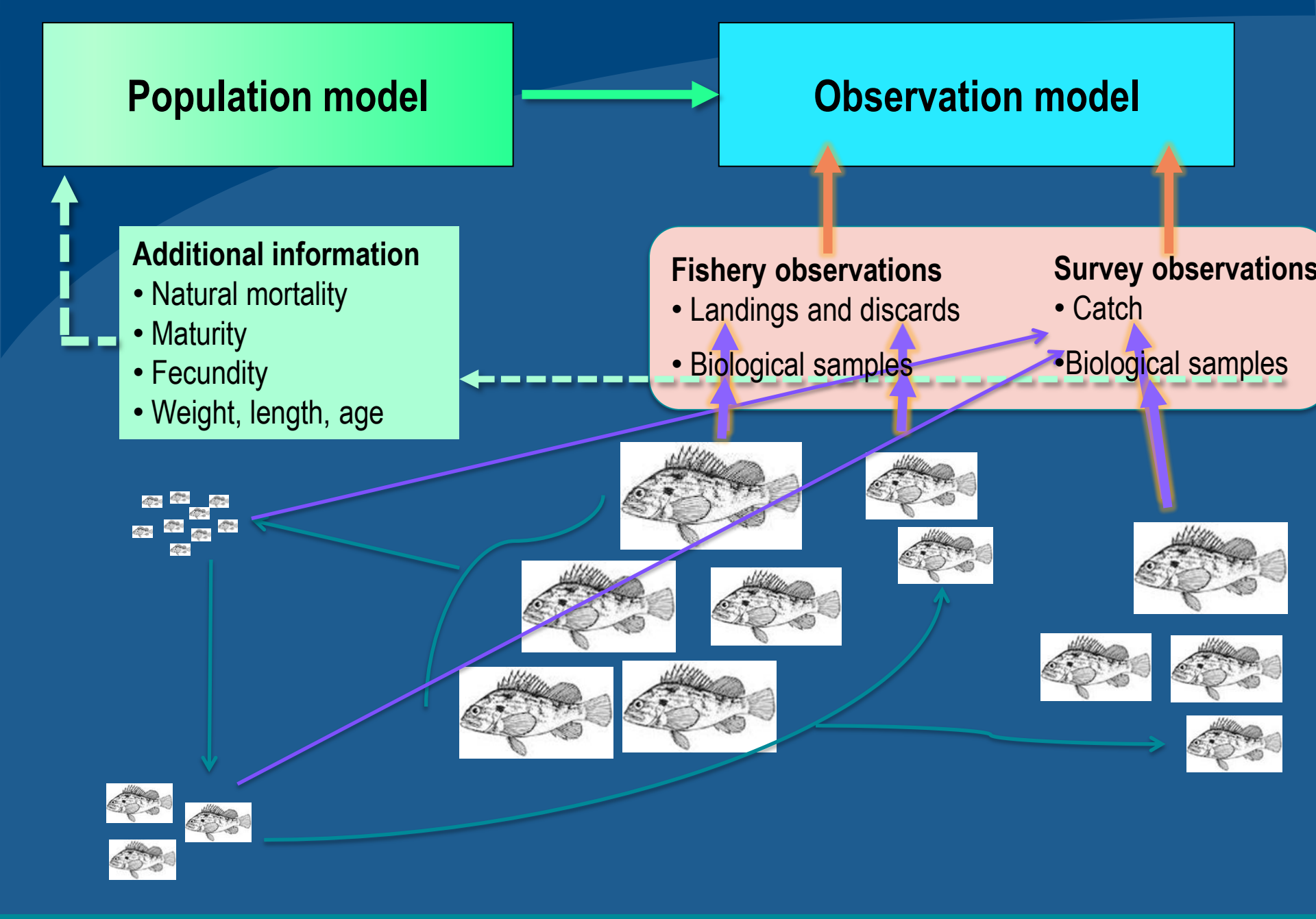
Scale, Status and Productivity







- Scale: Absolute level of biomass
- Status: Relative level of biomass
- Productivity: Rate of new biomass


Population model
Observation model
Additional information
• Natural mortality
• Maturity
• Fecundity
• Weight, length, age
Fishery observations
• Landings and discards
• Biological samples
Survey observations
• Catch
•Biological samples

Four Levels of Assessments

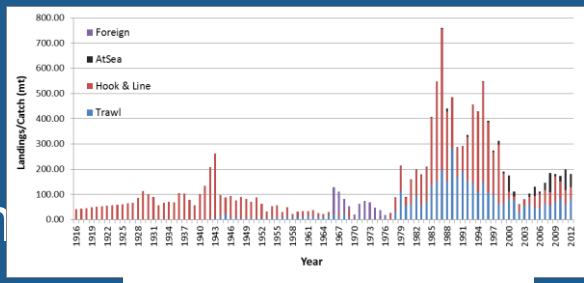
- Benchmark (Full)
- Update
- Data Moderate
- Data Poor

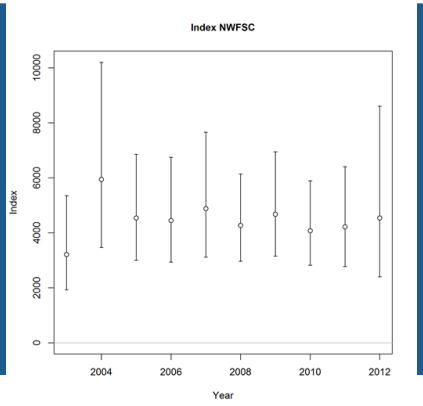
Benchmark Assessments

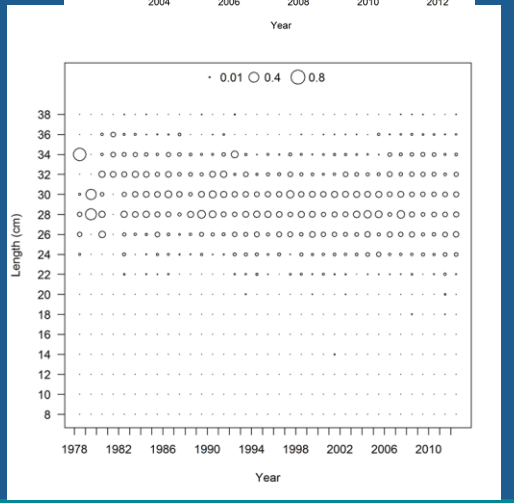
- Typically use Stock Synthesis: flexible platform for including catch from multiple fisheries & surveys, age & length data
  - estimation of selectivity, natural mortality, productivity, recruitment, stock size; use of Bayesian priors
- Considerable exploration of uncertainty and model sensitivity
- Max. likelihood estimates of OFL (using MSY proxy) and status (% of SB0);
- Independent, interactive 4-5 day peer review of two assessments (STAR process), with final SSC review
- Used for 34 species since 2000

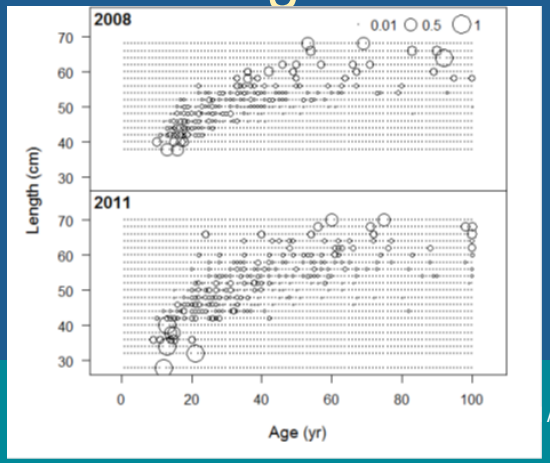
Benchmark Assessments - Data

- Catch data (landings and discards)
  - Key for estimating population scale/productivity
  - Biological sampling informs impact on population
- Indices of abundance
  - From surveys or fishery catch/effort data
  - Fishery-independent preferred; more consistent for population trends and structure (bio-sampling)
- Maturity/fecundity data inform spawning output
- Length data simpler to collect than age data
  - Both inform estimates of population structure

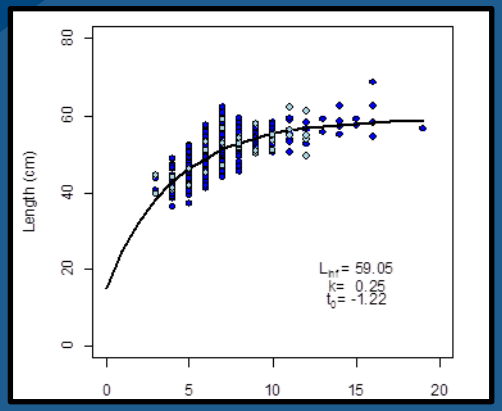


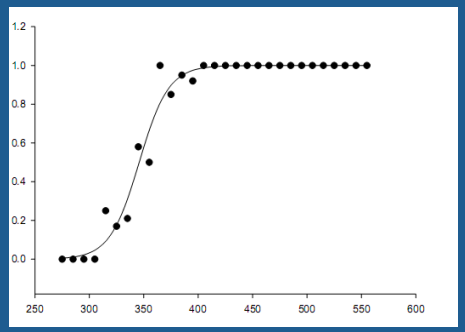


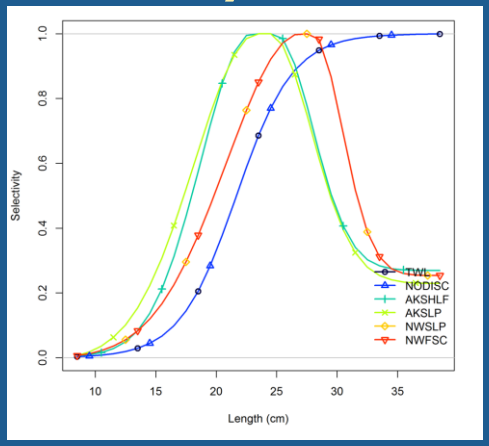


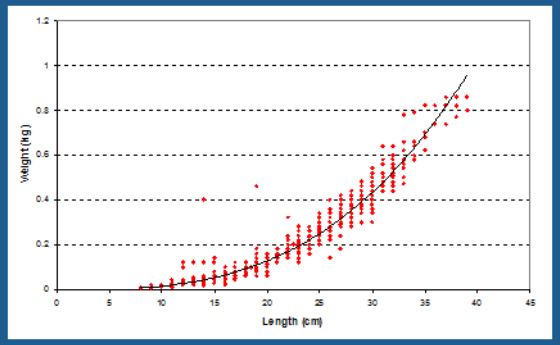


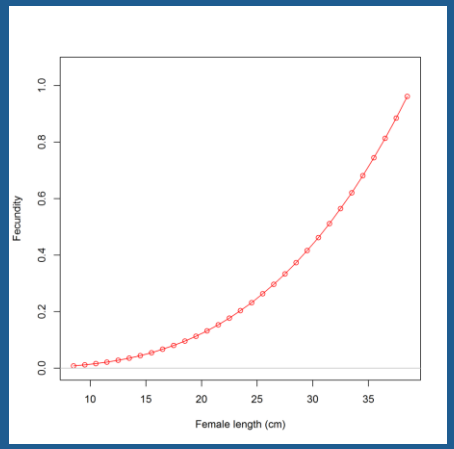
Benchmark Assessments – Parameters (input or estimated)

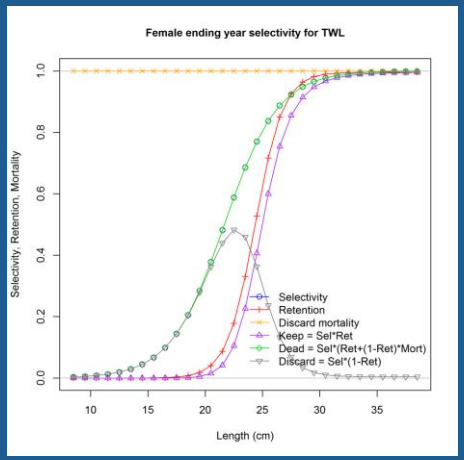






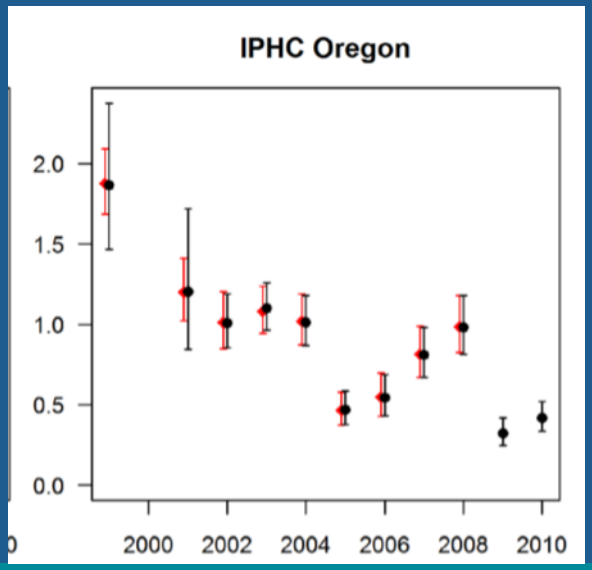






Update Assessments

- Updates of prior Benchmark assessments
- New/revised data in previously used series; no new series
- Model structure remains the same
  - Previously estimated parameters remain estimated
  - Previously fixed parameters remain fixed
- Reviewed by SSC
  - following initial review by SSC Groundfish Sub-committee



Data-moderate Assessments

- Recently-developed, intermediate option
- Models rely on catch data, 1 or more abundance indices, and assumptions about parameters
- Methods underwent independent peer review
- 2013 assessments used STAR process;
  - eventually, assessment results reviewed by SSC only
- Provide estimates of OFL and stock status
- "Adequate" assessments, developed/reviewed with fewer resources
- Successful initial use for 8 species in 2013

Data-poor Assessments

- Catch data only. Simpler models, rely on probability distribution assumptions about current depletion and other parameters, and species-vulnerability ratings
- Produce uncertainty estimates, but model sensitivity not explored
- Methods underwent independent peer review
- Assessment results reviewed only by SSC
- Provide information to set OFLs, but not stock status; generally a one-time analysis.
- Have been used for 50+ species since 2009

Council/SSC Assign Assessments to 1 of 3 Categories

- Most **benchmark/update** assessments in **Category 1**
  - Those considered more uncertain may be placed in Category 2
- **Data-moderate** assessments in **Category 2**
- **Data-poor** assessments in **Category 3**
- Default scientific-uncertainty reductions from OFL to ABC
  - **Category 3 > Category 2 > Category 1**
- Assessment uncertainty can supersede default, if larger

Categories

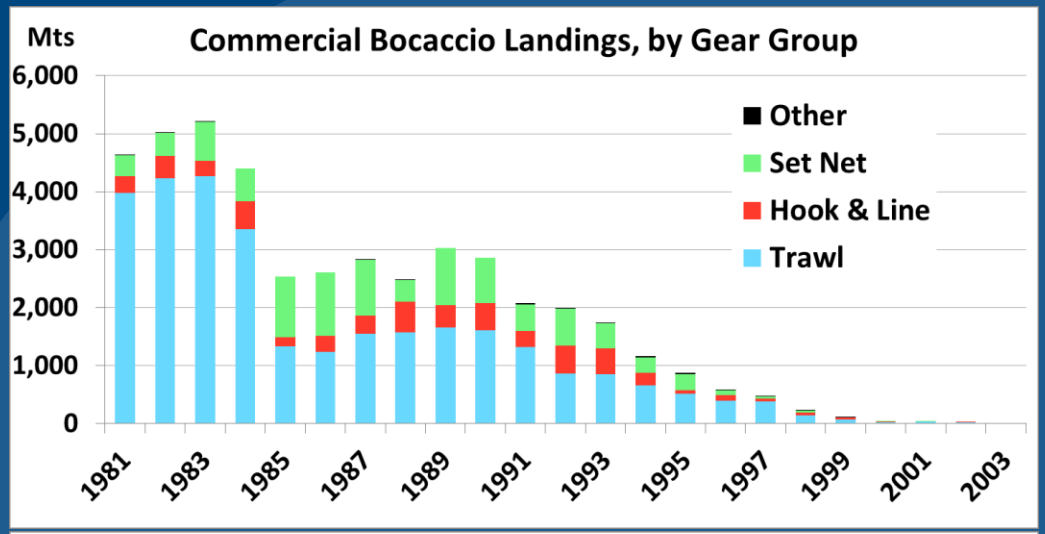
Stock category	Assessment type	Data types	Quality
1	Statistical Catch at Age (SCA)	Catch, detailed life history, indices, length/age comps.	
2	SCA, S-P, index-based methods, *M*	Catch, basic life history, indices	
3	Catch-only;	Catch, basic life history,	

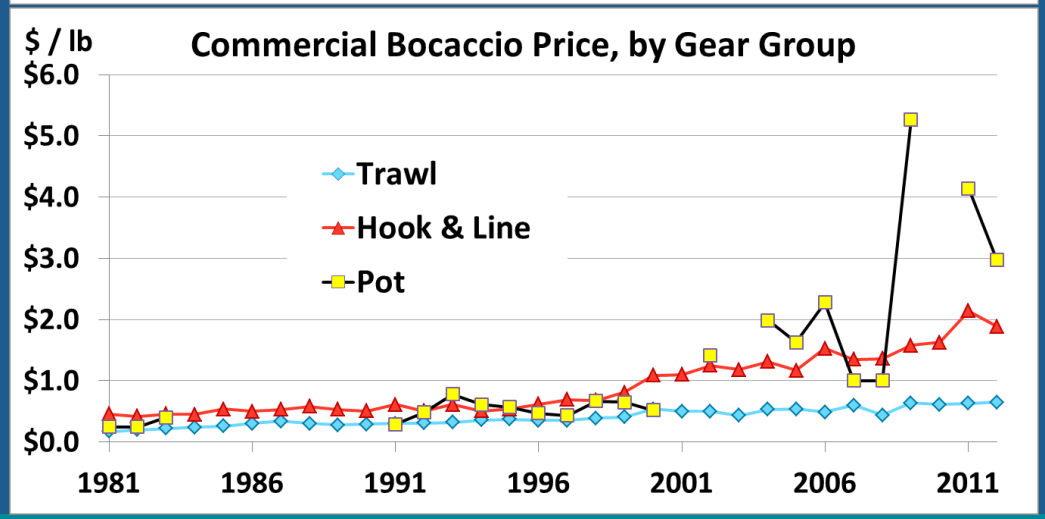
Brief Look at Three Species

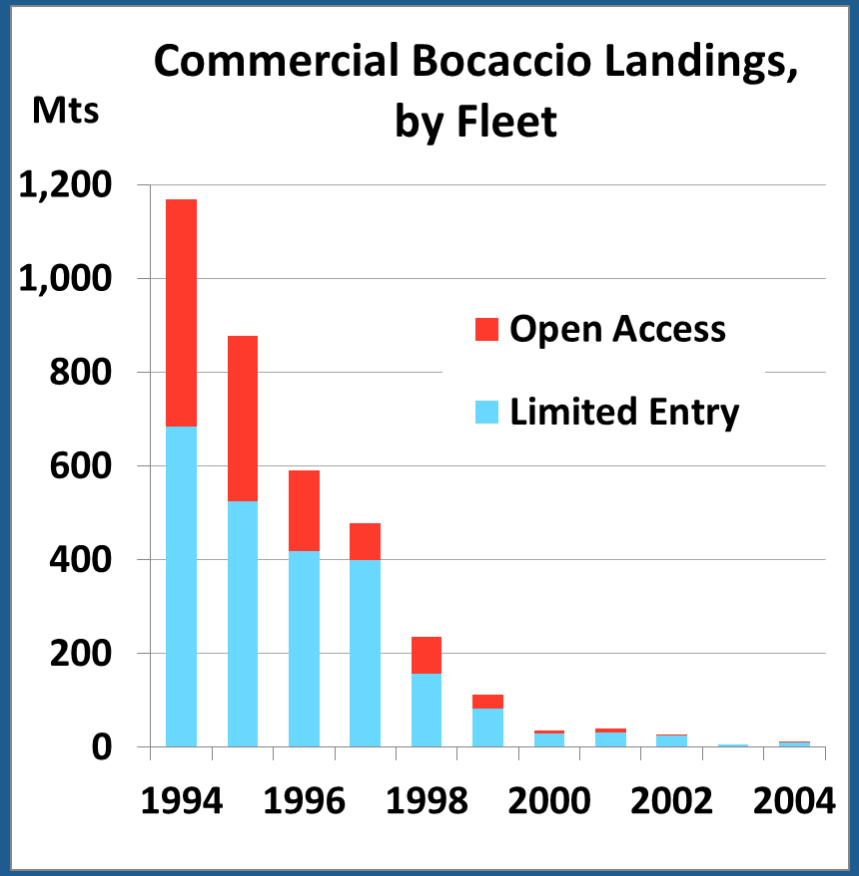
- Bocaccio
  - A rockfish that is most abundant off Central and Southern California
  - Under rebuilding since 1999
  - Important to recreational and commercial fisheries
- Petrale sole
  - Valuable, principally trawl-caught flatfish species
- Sablefish
  - Very important to most non-hake commercial sectors

Bocaccio

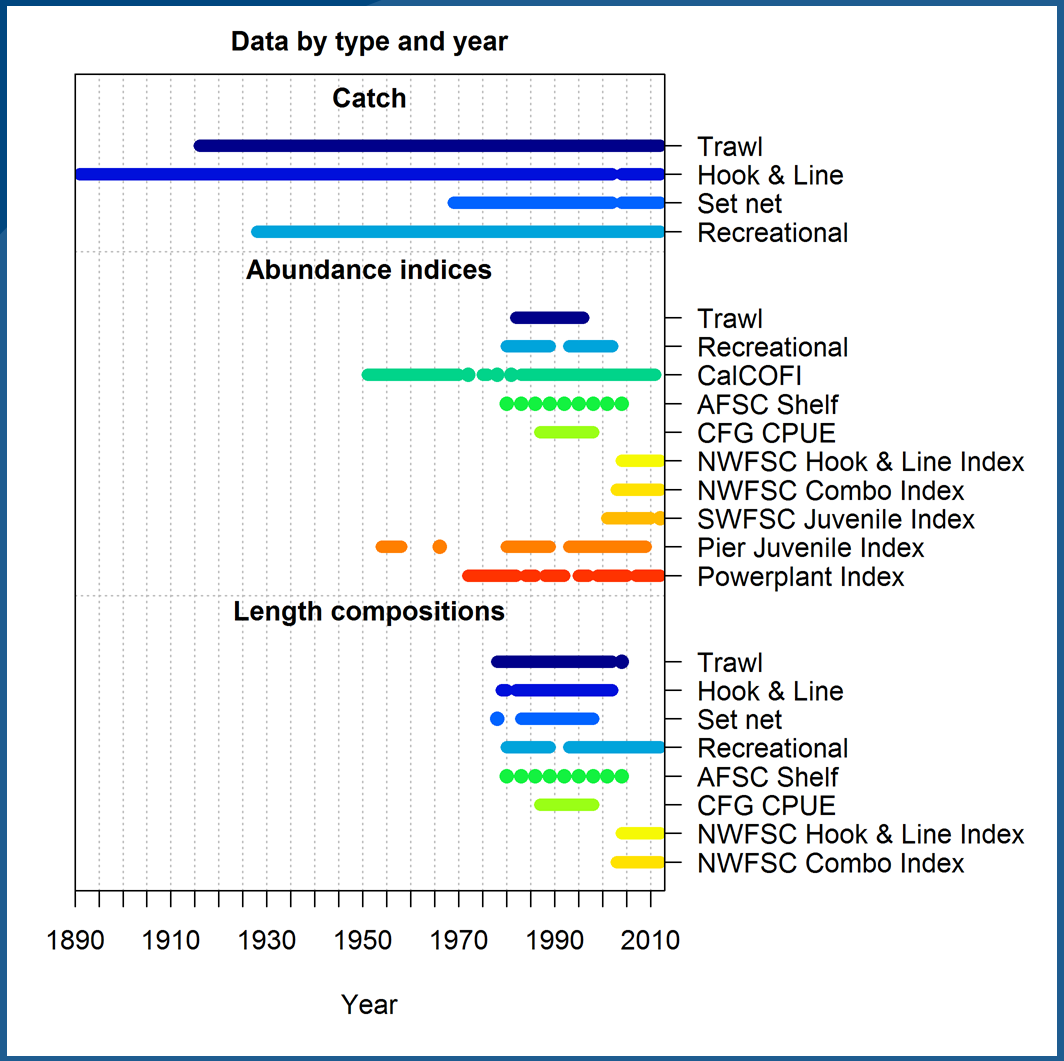
Popular California rockfish; one of 1st 3 species declared overfished



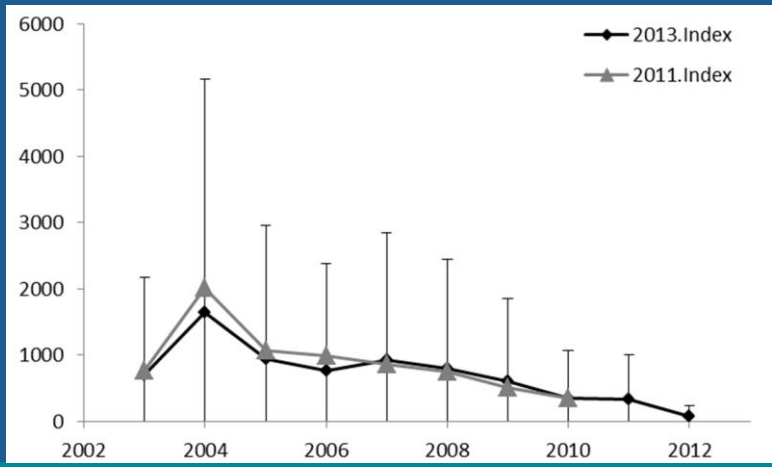




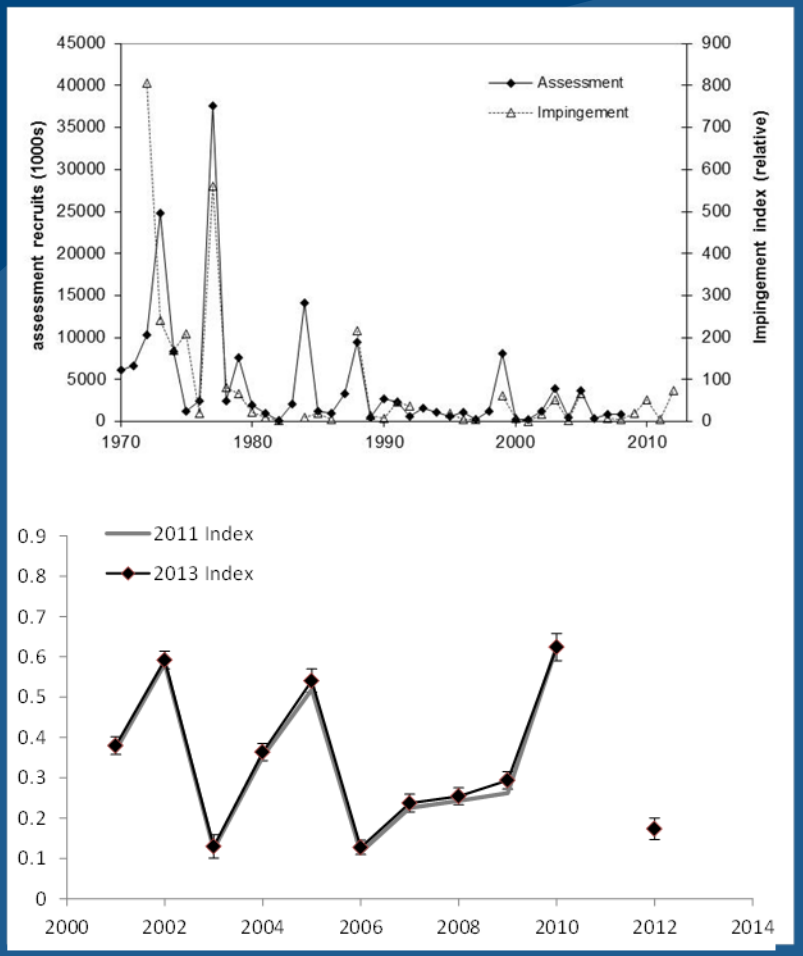
Bocaccio Assessment



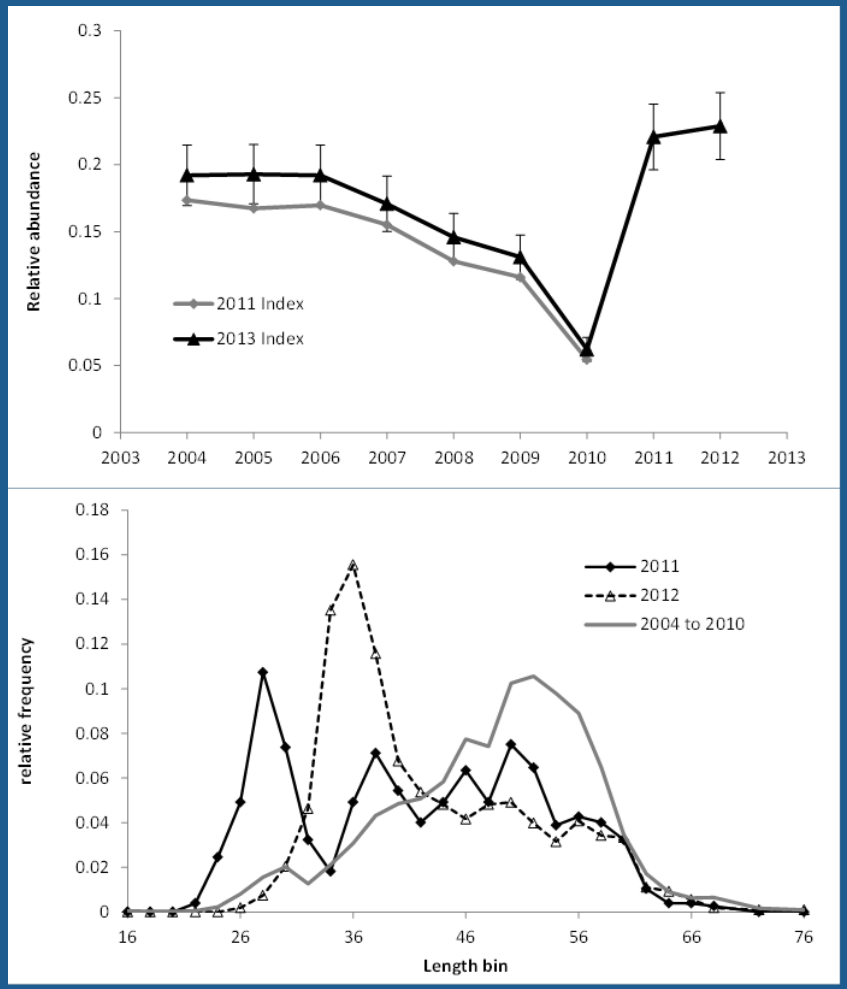
- Uses a variety of indices to capture different life stages, habitats and time periods
- Difficult to age
- NWFSC index does not reflect recent recruitment



Bocaccio Assessment



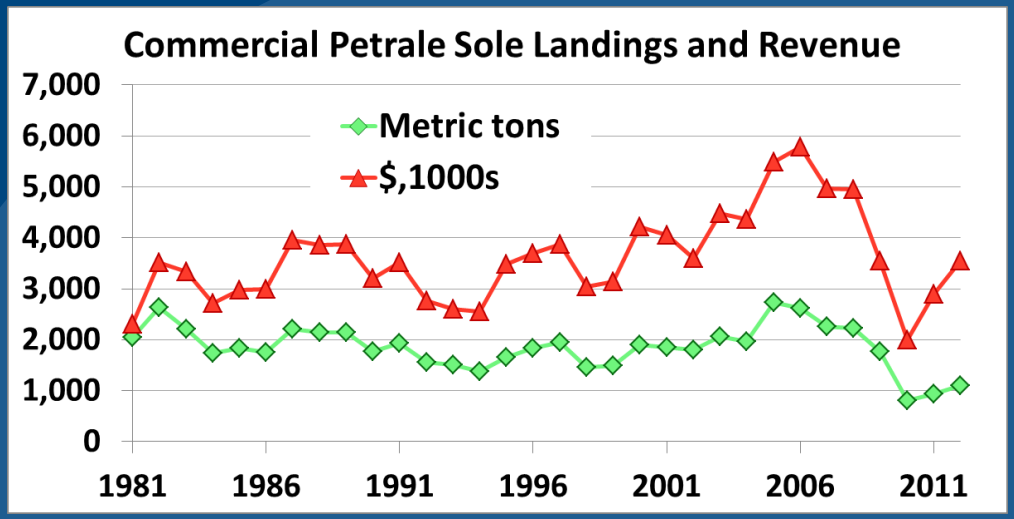
Juvenile indices- impingement (top) shows good 2010, 2012 YC's, trawl survey (bottom) shows strong 2010, weak 2012 (no coastwide data in 2011).

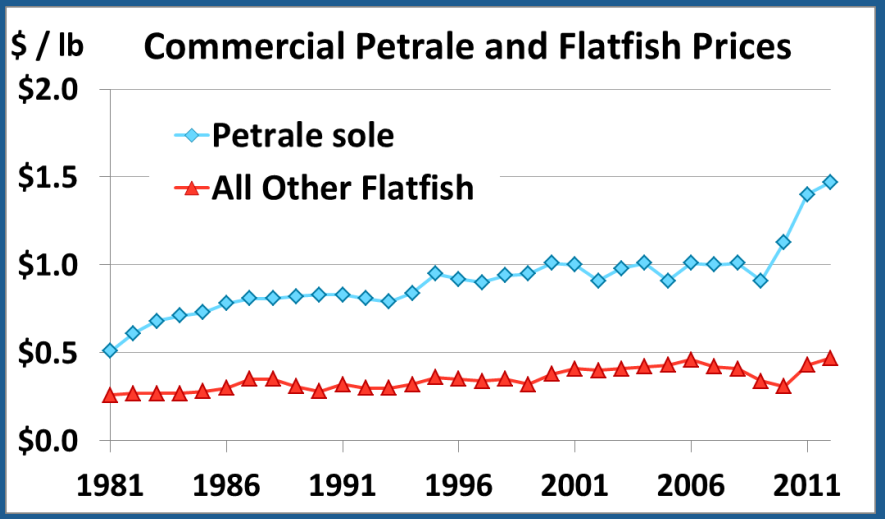


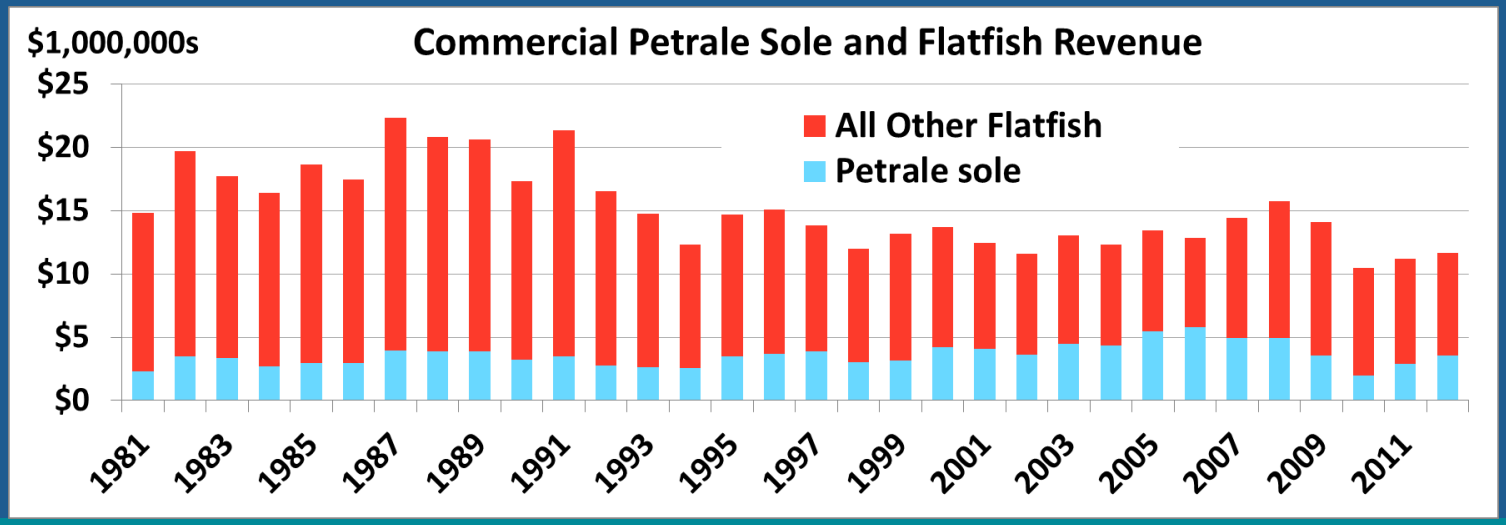
NWFSC Hook and Line Survey- sharp increase in 2011-12, LFs show strong 2010 (and decent 2009) YC (also in rec. Fishery LFS)

Petrale Sole

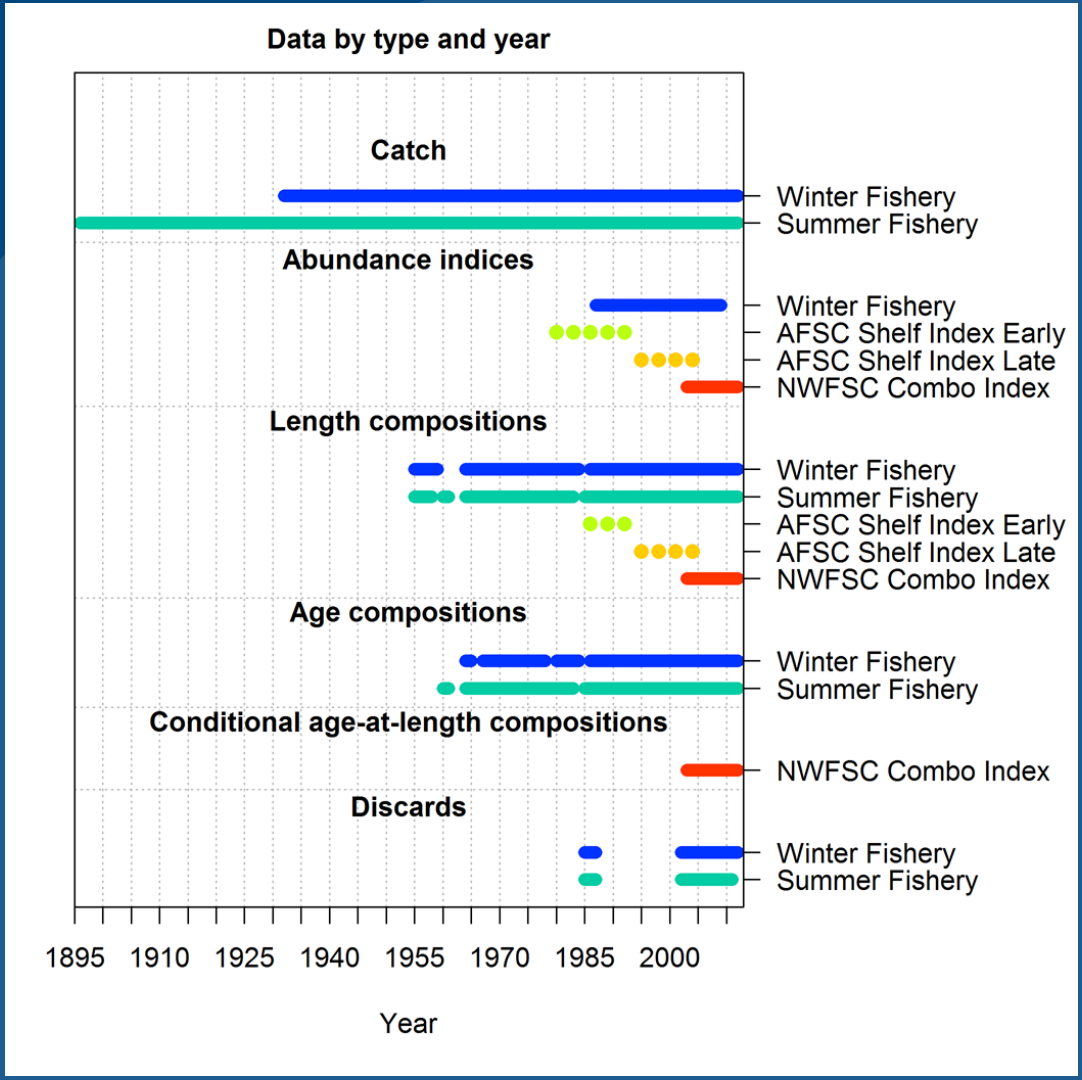
High-valued flatfish; caught with trawl gear from central CA north



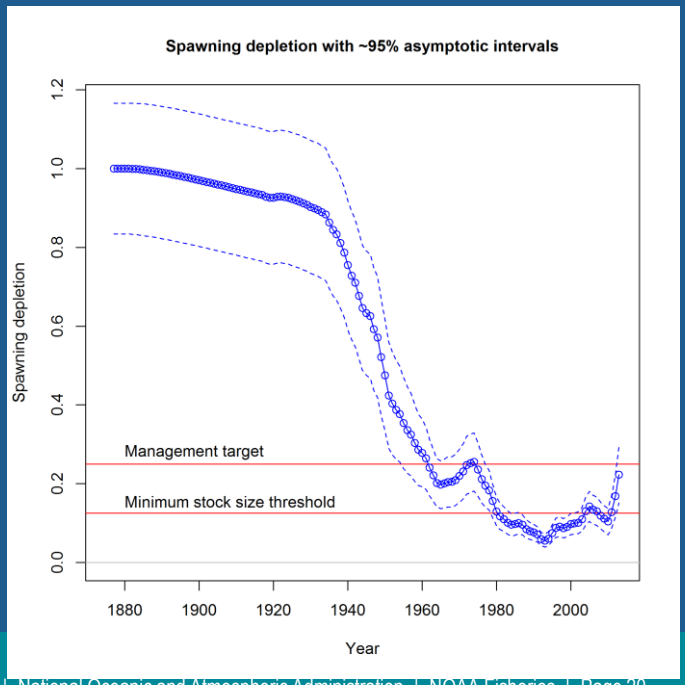




Petrale Assessment



- Age-validation using bomb-radiocarbon analysis
- Evaluation of historical ageing
- Two seasonal fisheries reflect different targeting and selectivity
- Extensive modeling to develop Winter Fishery CPUE index prior to inclusion in model.



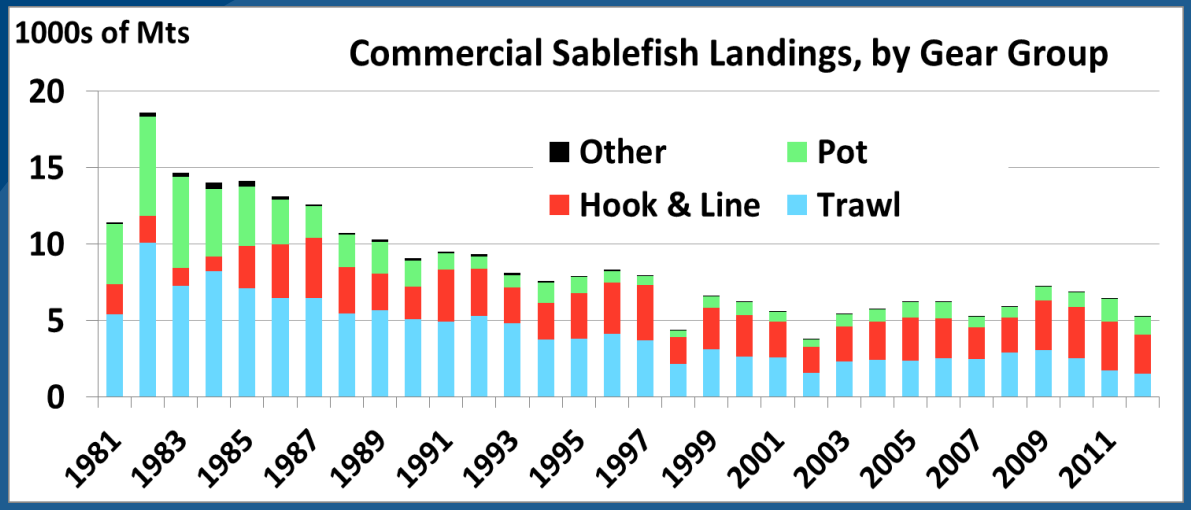
Petrale Assessment

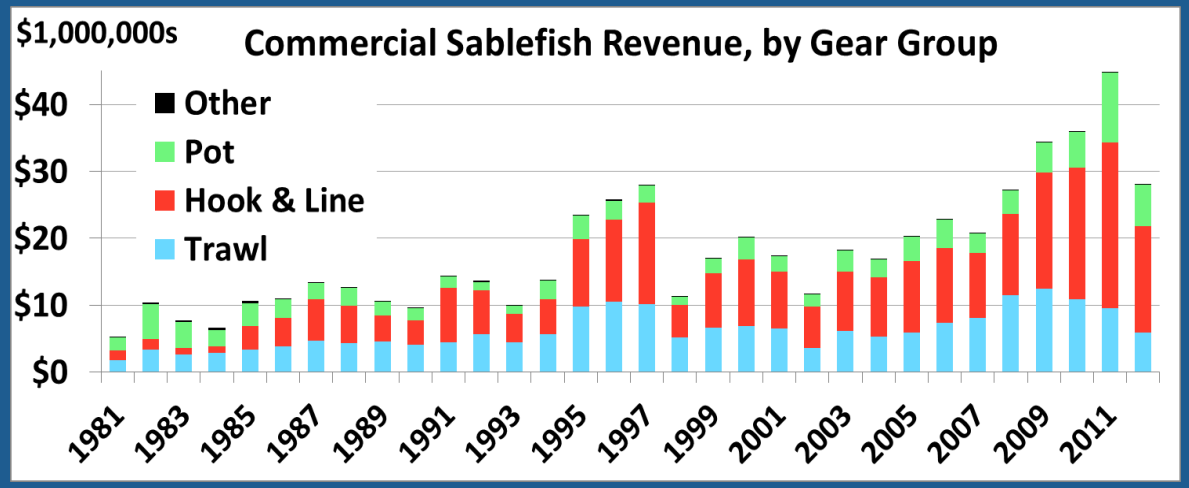
Research and Data Needs

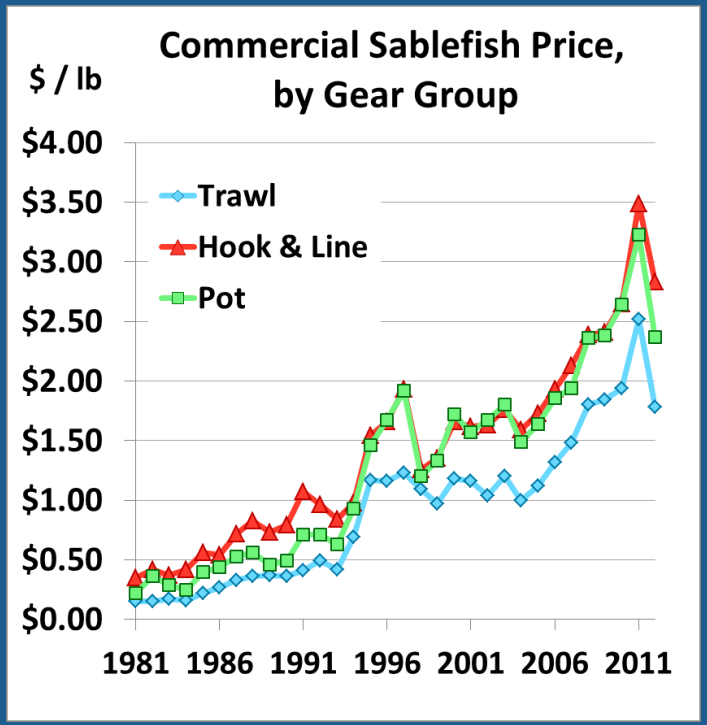
- Comprehensive WA landings reconstruction
- Update of maturity and fecundity relationships
- Increased collection of age data, particularly in the South
- Re-aging of historical otoliths with modern methods
- Impact of the Catch shares program
- Stock structure and movement
- Extent of spatial variability on productivity processes (e.g. growth, maturity, recruitment)

Sablefish

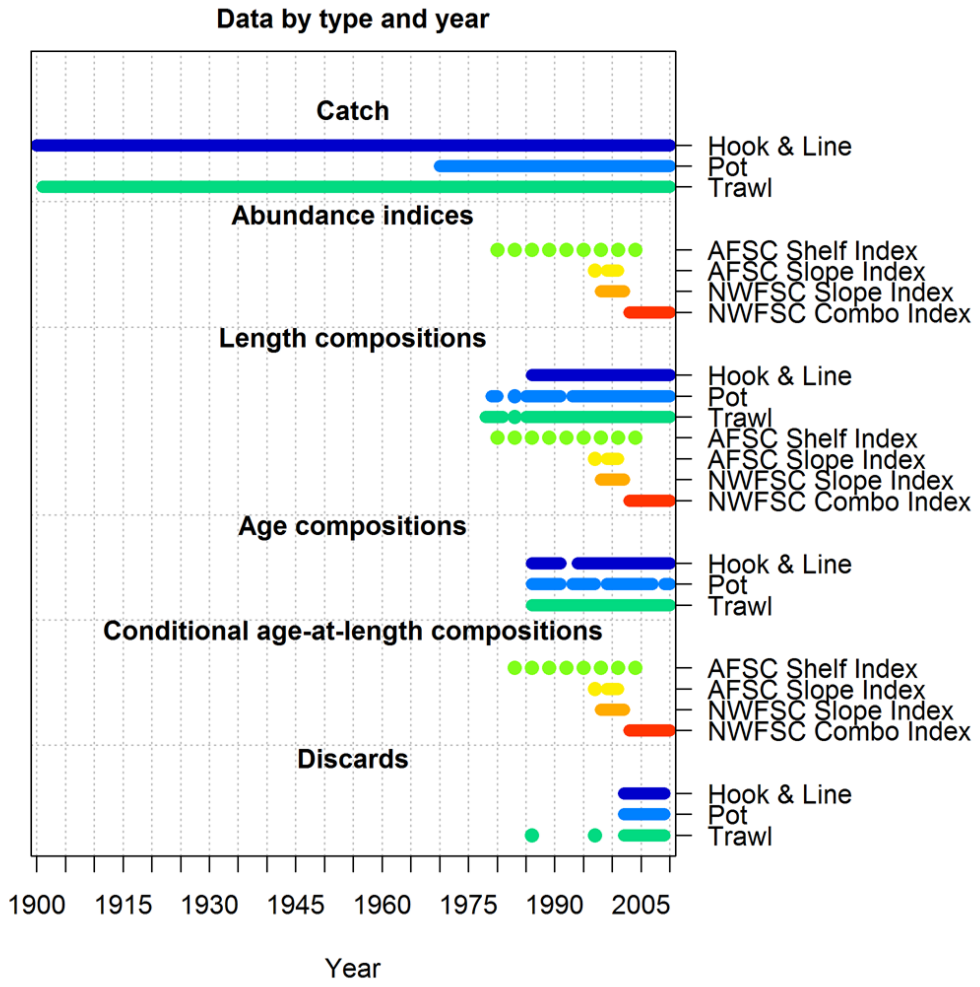
High-priced groundfish; broad geographic and fleet importance



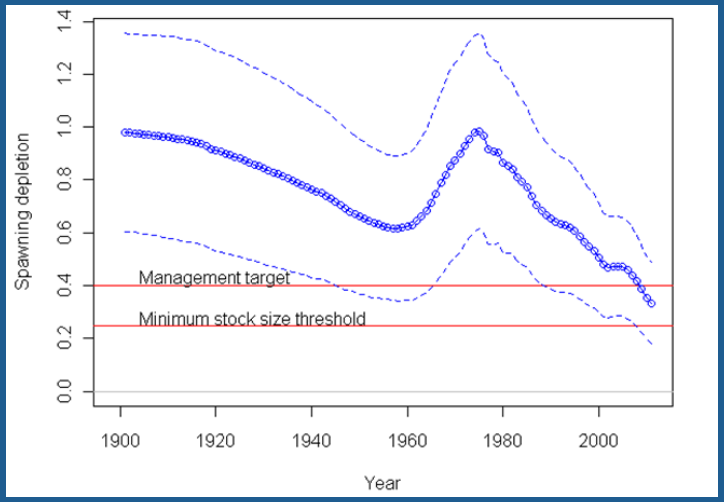




Sablefish Assessment



- Evaluation of environmental time series and recruitment survey.
- Fishery selectivity changes determined by historical regulation changes.
- Survey conditional age-at-length informs both age composition of population and growth parameters.
- Age data from fishery provides information on age composition of population and removals.



Sablefish Assessment

Research and Data Needs

- Continue the annual NWFSC shelf-slope trawl survey time-series.
- Investigate aging methods that may be more precise than current methods.
- Investigate residual patterns in the fit to larger cohorts in the composition data.
- The routine collection of samples for maturity and fecundity.
- Greater age sampling.
- Comprehensive WA landings reconstruction.
- Joint assessment with Canadian and Alaskan scientists due to stock migrations and broad distribution.
- Evaluate methods to capture information regarding environmental and ecosystem variability.
- Investigate the accuracy of the dressed to whole weight conversions used to estimate fishery landings.

Summary

- Stock assessment uses fishery and survey data to estimate
  Scale, Status and Productivity of a stock.
- Different levels of assessment used based on data available (and sometimes time and workload) .
- Assessments placed in Categories based upon level of assessment as well as uncertainty in data and model outputs.
- Even Benchmark/Category 1 assessments have opportunity for improvements in data and modeling.
- Different species/stocks have different challenges and different solutions for providing informative data for assessment.

Strengths

- Advanced stock assessment software allows for inclusion of wide variety of types of data and modeling choices.
- Variety of assessment methods allow for providing management advice for stocks with different amounts and types of data.
- Variety of Surveys and Fishery data collection programs provide data for stock assessment.

Challenges

- Lack of coast-wide comprehensive survey in untrawlable habitat.
- Inability to accurately age otoliths (or other structures) for a number of species
- Many stocks cross international boundaries but surveys and fisheries generally do not.
- Large number of species and small number of assessment scientists.
- Often a delay in observing the size of a new recruitment

Solutions

- Develop visual, hook and line, pot or other surveys for untrawlable habitat
- Continue to explore and improve ageing methods
- Work to collaborate across borders
- Continue to improve efficiency of data management, analysis and assessment.
- Continue to explore environmental indices that correlate with recruitment, and other methods to estimate recruitment strength.